Preface

Finance has always taken advantage of technological innovation. No sooner had the telegraph been invented than traders were using it to arbitrage the price of stocks across cities. With the telephone, came the first forms of home banking. The introduction of computers transformed stock exchanges from overcrowded and loud pits to silent rooms filled with microprocessors. Yet, for most of the last two millennia, technological innovation has only allowed finance to do roughly what had been done before, but better, faster, more cheaply. The loans granted in the 1990s were not so different from the loans described in the Hammurabi code (1754 BCE) nor was it different the way those loans were granted almost four millennia later.

To be sure, technological innovation in finance has allowed financial transactions to be carried out at scale. At the end of the last decade of the 20th century, for example, enormous amounts of money were wired daily around the world, credit and charge cards became the standard form of payment around most of the developed world, and credit started to be granted with credit score models. Still, international wire transfers were just a faster version of the letters of credit used during the Crusades. Credit card payments were a more sophisticated version of store credit, present since stores were invented. Even the most advanced credit score models resemble very closely the way yesteryear bankers were granting credit: they were using the same qualitative and qualitative variables. In other words, technology reduced the cost of collecting and processing information, but it did not substantially change the business of making payments and loans nor did it eliminate the essential frictions these involved, from adverse selection to
moral hazard. A loan at the time of Hammurabi faced roughly the same moral hazard and adverse selection risk of a loan at the time of Bill Clinton.

Not only did technological progress in the past not disrupt the way finance was done, it did not disrupt the existing financial institutions, which were the only institutions with the scale and resources to apply these innovations first. Thanks to the telegraph, stock exchanges became more efficient. Thanks to automated tellers, incumbent banks were able to reach every corner of the earth. Thanks to computers, large trading houses could reduce the cost of trading to a fraction of what it used to be.

At the beginning of the third millennium, however, the confluence of three major innovations has started to revolutionize the way finance is conducted. The first is the introduction of the first smartphone, the iPhone, in 2007. Thanks to smartphones, today’s average individual has at her fingertips a thousand times more computing power than was necessary to send man to the moon, more information than the best library used to contain, and more communicating power than any propaganda machine ever dreamed of possessing. More importantly, smartphones convinced most human beings to wear tracking devices, once reserved only for convicted felons on parole. Not only is it now possible to know whom we have talked to, but also where we have been, near whom, and for how long. Smartphones can track what searches we carried out, what books we bought, what vacations we shopped for, what dreams we have, and which diseases we fear to have. The latest iterations of smart devices add biometric information to the mix. These allow phones to capture additional information that we may not know ourselves. The smartphone knows when you are stressed, when you are low on sugar, and when you like a person of the same or opposite sex. In so doing, smartphones have enabled a degree of constant surveillance, a panopticon, that even Bentham or Orwell would have
struggled to conceive. While this surveillance poses very serious political problems, it does create enormous opportunities to eliminate the frictions of financing.

These frictions are largely related to the asymmetry of information. Adverse selection and moral hazard problems are intrinsically linked to the inability to observe some individual characteristics or some actions, respectively. In fact, adverse selection used to be called “hidden information” and moral hazard “hidden actions”. If neither information nor actions can be hidden, the financing frictions related to asymmetry of information, which have dominated the finance literature for the better part of the second half of the 20th century, are eliminated.

In addition, smartphones have also reduced, if not eliminated the cost of coordination. All human exchange requires some degree of coordination. A buyer needs to find a willing seller and vice versa. From the Roman forum to the Middle Age fair, this coordination has been resolved through the creation of physical places where people could meet. Geographical distance, however, constituted a major impediment to the liquidity of those markets, as it did the cost of spending the better part of a working day waiting for the counterparty to show up.

To facilitate the matching of buyers and sellers and create liquidity, standardized contracts were created. Commodity futures contracts, for example, carefully specify what has to be delivered, when it should be delivered and where it should be delivered.

Smartphones have solved all these problems. Buyers and sellers do not need to meet in the same physical location, since they can easily find each other in cyberspace, as eBay or Taobao has shown. Buyers and sellers do not need to spend time waiting for each other, because thanks to the internet, they can arrange to meet virtually at pre-determined time in a virtual space. Facilitating liquidity, these innovations have reduced the need for standardization. If a
buyer can find a seller matched along all the dimensions she values, she does not need to converge to the standardized liquid market, but she can trade in a bespoke one.

On the one hand, this flexibility has enormously expanded the options for individuals. On the other hand, it has led to a privatization of many of these markets. When a physical location was involved, the market itself was either publicly owned or jointly owned through a cooperative. In contrast, virtual markets are generally owned by a private entity, which maximizes its profits, not necessarily the quantity traded.

Finally, smartphones have radically changed the customer experience. Historically, merchants have chosen what to show to a customer and how to show it. The only limitations were imposed by regulation and/or competition. But competition only worked inasmuch as customers interacted repeatedly with the same firms. In most consumer financial transactions, however, customers participate in the market relatively infrequently (for example, when buying a house) and sometimes learn about their mistakes only many decades later (for example, when they buy insurance, or when they invest in pension funds). The computing power of the smartphone, however, can dramatically change this situation. Information can easily be collected and rearranged in a customer-friendly way. Even legal clauses can easily be scanned by an algorithm and be flagged out as potentially dangerous for the uninformed customer.

While the smartphone is by far the most important innovation, its applications to financial services would be relatively limited if it were not for parallel developments in artificial intelligence (AI) and cryptography. Most human beings do not have either the time or the ability to interpret the massive amount of data produced by smartphones. Artificial intelligence has been defined as the “ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation” (Kaplan and
Haenlein (2018)). Thus, the application of AI to the massive amount of data produced by smartphones changes the way financial services are offered and the way they are purchased. The use of AI need not be benign. It is possible to imagine your smartphone monitoring your sugar levels and sending you an advertisement for an impulse buy of clothes when your sugar levels are low and you have little ability to resist.

Transacting at a distance, without trusted intermediaries, would be too costly without the modern developments in cryptography. Currently, securely transferring payment and other confidential information requires use of a trusted intermediary, usually a bank, who extracts large rents for this certification role. Commodity trade finance for example, is a complicated process that involves exchanging signed original paper letters of credit that require frequent amendments and involve participants from around the world who do not know each other. By putting the verification process onto an immutable encrypted blockchain allows buyers and sellers to transfer information with no possibility of tampering, and most important, no central rent-extracting intermediary.

In sum, the combination of smartphones, AI, and cryptography is revolutionizing the way finance is provided. As with all revolutions, the fintech one is likely to bring about a lot of improvements but will also leave a lot of blood in the streets. In this handbook, we try to provide a comprehensive analysis of the way in which the provision of financial services is changing, through a series of contributions by leading experts. We also try to provide a reasoned guide of how this evolution will change the financial landscape. By its very nature, this is a speculative exercise, since revolutions often take unexpected directions. Nevertheless, we think it is a necessary step towards an understanding of the changes that are taking place under our eyes.

We are finishing this handbook as governments around the world respond to the COVID-19
virus with policies that have dramatically slowed economic activity. While no one can predict with certainty what the post-COVID financial services landscape will look like, early evidence suggests that the rate of adoption of digital financial services is accelerating in many countries as a result of the crisis. As a result, regulators and policy makers may be confronted with many of the issues raised in this handbook much sooner than we would have anticipated even six months ago.

In analyzing these changes, we will distinguish to what extent they are opportunistic or really value enhancing. In some instances, the opportunistic nature of the changes is clear, as when technology is applied to arbitrage regulatory requirements. In others, it is ambiguous. If applied by all lenders, a better way to screen borrowers helps allocate credit where it is most needed. Yet, when one lender introduces a better credit-scoring model, she also benefits by being able to dump hidden bad credit risks to her competitors. For example, a US Midwest insurance firm, Root insurance, uses detailed smartphone location and acceleration data to target only careful drivers. Other insurance companies in the area not using this technology are stuck with poor drivers. Similarly, using AI to make credit allocation decisions, might lead to discrimination on racial, gender, or geographic grounds.

Technology is not intrinsically good or bad. The same computational power that enables banks to maximize the number of overdraft fees charged to their poor customers also empowers new companies to offer a management system to their customers for free to avoid the very same charges. What makes technology good or bad is the use we make of it. Competition and regulation determines the way technology is used and, thus, whether it is used to the benefit of humankind or to its detriment.
As economists, we should know that competition plays a crucial role in ensuring that technology is used for the benefit of everyone, yet all too often we forget this truism. With all its benefits, technological innovation carries also a major risk: a tendency toward monopolies. The increasing return to scale provided by data, the close to zero marginal costs of expanding a digital business around the world, the network externalities present in many of the finance functions, like payment, create the conditions for a winner-take-all market. In the United States, the entrenched position of existing players makes this tendency less visible, but in other countries, where the incumbents are weak or non-existent, it is blatant. Kenya provides a striking example. While M-Pesa created an efficient way to transact at a distance, providing access to financial services to a mostly unbanked population, it did so by creating a monopoly in the payment market and conferring enormous market power to one mobile communication player. As a result, Kenyans have to pay hefty margins for both services. In China, where financial institutions were not very developed, Ant Financial is creating a conglomerate with a dominant position in all services, from payments to credit, from wealth management to insurance. Its power is not limited to China. Ant Financial has major stakes in mobile payment systems the world over: from PayTm in India to PayGo in Indonesia, from Kakao Bank in Korea to MercadoLibre in Argentina.

Network externalities and increasing return to scale, however, are not just immutable technological features, they are also the product of regulatory choices. If phone companies do not enjoy network externalities, it is because regulation forces all phone companies to accept calls coming from the clients of other companies. In the same way, the reason why we can easily switch from a mobile provider to another, carrying our phone number with us, is because in most developed countries, regulation has forced companies to accept number portability.
The same is true in most finance markets. Mandatory interoperability could resolve the monopoly problem in the Kenyan payment system. The problem is that interoperability needs to be not only mandated, but also enforced, which is not always easy when a lot of technical steps are involved. Interoperability is better achieved by creating a common standard through a public-private partnership, like the Unified Payment Interface developed in India by the National Payments Corporation, a not-for-profit enterprise owned by the Reserve Bank of India and a consortium of major banks.

As network externalities can be eliminated, so can the barrier to entry created by data ownership. If the ultimate ownership of the data is allocated to customers (as done in Europe), customers can easily transfer their data across banks to create more competition for their business. This is the purpose of the European Open Banking directive, which mandates an open Application Process Interface (API) to enable clients to transfer data across banks. While at the time of writing, the practical success of this initiative is still in question, it clearly goes in the right direction.

In the world of finance, especially household finance, competition—while necessary—is not sufficient to ensure that technology will bring benefits to everyone. This is where regulation plays a crucial role: regulators are entrusted with the very difficult role of separating the social value of innovation from its market value (i.e., its ability to generate profits). Faced with this challenge, it is easy for regulators to fall in one of the two extremes. One extreme is the “just say no” approach. After all, no regulator loses her job for failing to license a new start up. At the other extreme, there is the techno-optimist regulator who, inspired by the potential of the technology or by a lucrative future career in the industry, considers all profitable innovation as
welfare enhancing. For this reason, it is especially important that regulators understand not only how technology is changing finance, but also what the welfare effects of this innovation are.

Last but not least, financial regulators will share some of the responsibility in promoting competition. Historically, financial regulators were more concerned with financial stability than with competition, often happy to sacrifice the latter on the altar of the former. Today, if they want that technological improvements go to benefit consumers, financial regulators have to ensure a lively competition. This goal cannot be delegated uniquely to the antitrust authorities. When it comes to creating common standards, financial regulators have to play a major role, as played by the Reserve Bank of India for the Indian payment system. Performing this role, however, requires regulators to have the technical skills to understand how competition can be promoted in a rapidly evolving field. We hope this handbook provides them with a useful guide in this sense.

The chapters in this handbook have been authored by global academics and leading expert practitioners with a deep understanding of developments in technological finance and the implication for regulation and policy making. Their contributions are organized into six section, with each section addressing an aspect of technological finance of interest to regulators. The first section provides an introduction to technological finance from two perspectives. The chapter from Mingfen Lin and David Brown provides an overview of benefits and risks posed by new financing channels enabled by technology, such as digital-based microlending, as well as technology-enabled innovation like cryptocurrencies which could profoundly change how the financial system operates. The chapter contributed by David Chambers, Rasheed Saleuddin and Craig McMahon examine innovations in finance in a historical context, examining four cases with similarities to innovations emerging today. The authors examine the emergence of these
innovations in response to market demand and how the regulatory response to these developments evolved over time, highlighting the balancing act faced by regulators face attempting to facilitate innovation in the financial system while protecting consumers.

The second section of the handbook examines the technology innovation in payments and trading. It begins with four chapters examining the development of cryptocurrencies. Bhagwan Chowdry and Seoyoung Kim provide an overview of Bitcoin and explain the mechanics of the Bitcoin blockchain with the aim of dispelling common misconceptions that have emerged regarding blockchains and distributed ledgers. The following chapter by Jeongmin Lee, Christine Parlour and Uday Rajan addresses a central question in the minds of many regulators as they assess the risks and policy implications of cryptocurrencies: “are they economically new, or simply new technological packaging of something familiar?” The chapter by Diane-Laure Arjalies departs from an economic view of alternative currencies by providing a comparative analysis of three cryptocurrencies and one ‘complementary’ currency through the lens of a sociologist. Her analysis considers the production of the value attributed to each of these currencies and highlighting how their value is influenced by their social context. Gina Peiters closes out the discussion of digital currencies with her chapter comparing the form and structure of digital currency types. She highlights the tradeoffs that Central Banks face in deciding whether to issue a Central Bank Digital Currency (CBDC), and suggests that issuance of digital currencies by independent entities may have moved timing for CBDC outside of the control of the Central Banks.

The introduction of alternative payments systems in emerging markets and developing economies has had a significant impact on the economies of those countries and Kenya’s M-Pesa mobile payments system is an oft-cited example of this impact. The chapter authored by Njugua
Ndung’u and Alex Oguso provides an empirical study of the development of digital platforms for financial services delivery to mobile devices across sub-Saharan Africa since 2012, analyzing the impact on financial inclusion as the service offerings progressed over time from payments to savings to lending services in these countries. The chapter authored by Feyen, Frost, Natarajan and Rice builds on the preceding discussion of cryptocurrencies to consider the role for stablecoins in cross-border payments and remittances. The authors point out that while stablecoins have been proposed as instrument for improving financial inclusion and reducing the cost of cross-border remittances, they suggest that other digital innovation indicatives underway in payment will likely undermine the comparative advantage of stablecoin arrangements.

The Payments and Trading section of the handbook concludes with four chapters discussing asset tokenization. Gilles Hillary and Laura Xiaolei Liu begin with a review of different types of tokenized assets and highlight some of the challenges that Initial Coin Offerings introduced for regulators, including accounting, taxation and security. Joshua Gans and Neil Gandal contribute a critical analysis of various consensus mechanisms employed to validate information recorded on distributed ledger systems, and highlight the trade-offs associated with different mechanisms. The consensus mechanisms in public blockchains are highly decentralized, which introduces challenges for regulatory supervision regimes designed for highly centralized market infrastructure. In their chapter, Shin'ichiro Matsuo, Ryosuke Ushida, and Aaron Wright take inspiration from internet governance models to propose a multi-stakeholder ‘polycentric governance structure for the ‘permissionless innovation’ associated with decentralised systems. Steve McKeon and Derek Schloss survey the legal environment around blockchain applications such as smart contracts which do not fit easily within existing legal frameworks, and suggest that norms around these new applications will be the foundation for a new body of law. The
The application of blockchains in trade and exchange is examined in the final chapter of Section 2 authored by Hugo Benedetti, Stephen McKeon and Cameron Pfiffer. The authors survey the trading and exchange landscape and highlight the potential benefits that blockchain-based infrastructure can bring to these activities and identify significant barriers that need to be overcome in order to realise these benefits.

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